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Kurokawa

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(54) **ANGULAR BALL BEARING**

(75) Inventor: **Takanori Kurokawa**, Kanagawa (JP)

(73) Assignee: **NSK LTD.**, Tokyo (JP)

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F16C 19/16 (2006.01)
F16C 33/58 (2006.01)

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CPC ***F16C 19/163*** (2013.01); ***F16C 33/585*** (2013.01); ***F16C 33/586*** (2013.01); ***F16C 41/04*** (2013.01)

(58) **Field of Classification Search**
CPC F16C 33/58; F16C 33/583
USPC 384/513, 515, 516
See application file for complete search history.

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Primary Examiner — Thomas R. Hannon
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

An angular ball bearing includes an outer ring having a raceway surface on the inner circumferential surface thereof, a shoulder portion on one side of the raceway surface and a counter bore on the other side thereof; an inner ring having a raceway surface on the outer circumferential surface thereof, a shoulder portion on the other side of the raceway surface and a counter bore on one side thereof; and a plurality of balls provided between the raceway surfaces of the outer ring and the inner ring so as to be rotatable at a contact angle. The outer diameter dimension of the shoulder portion of the inner ring is larger than the inner diameter dimension of the shoulder portion of the outer ring, and the shoulder portion of the outer ring and the shoulder portion of the inner ring are overlapped with each other when viewed in the axial direction.

5 Claims, 6 Drawing Sheets

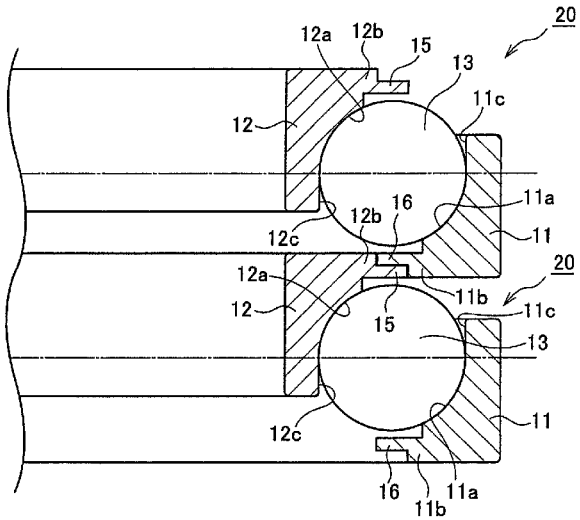

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FIG. 1

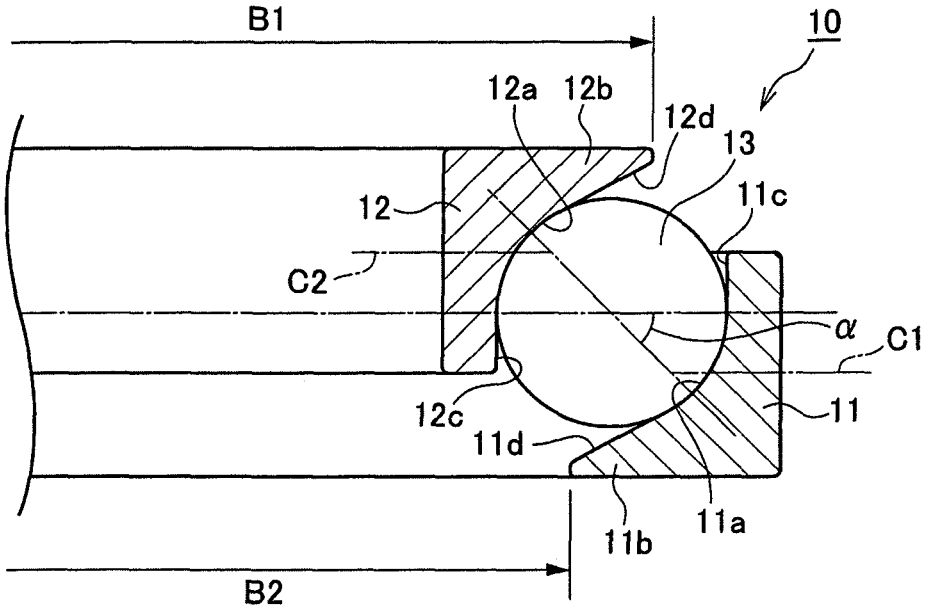
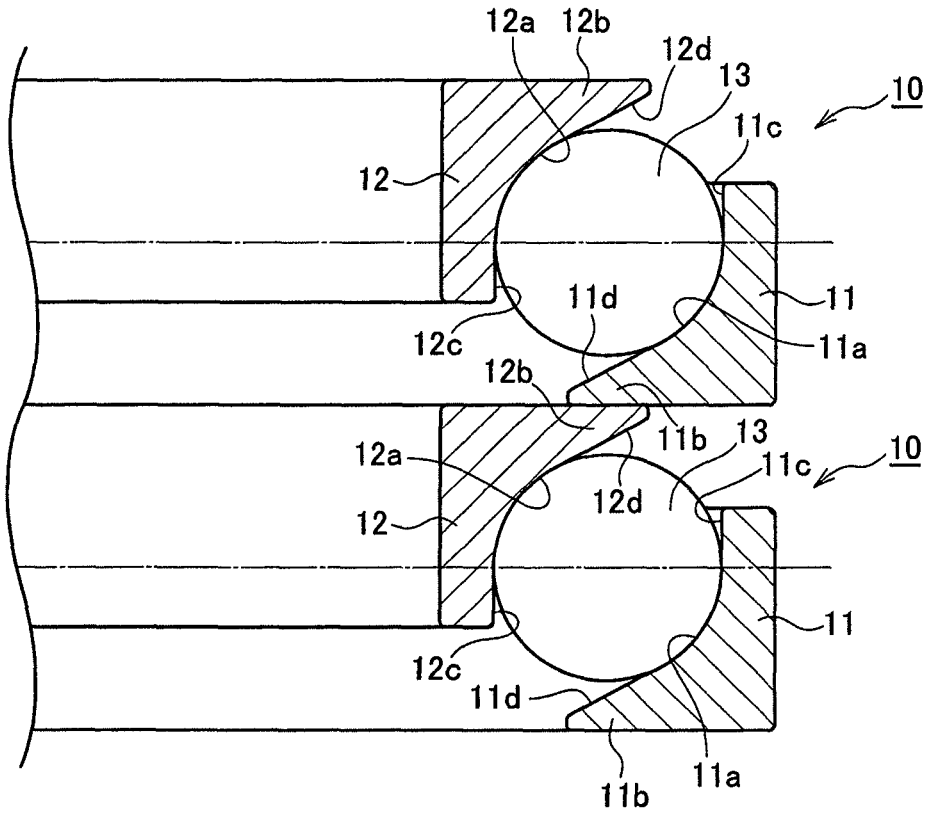


FIG. 2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12b
12d
13
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11c
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11d
11
12c
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11b
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FIG. 3

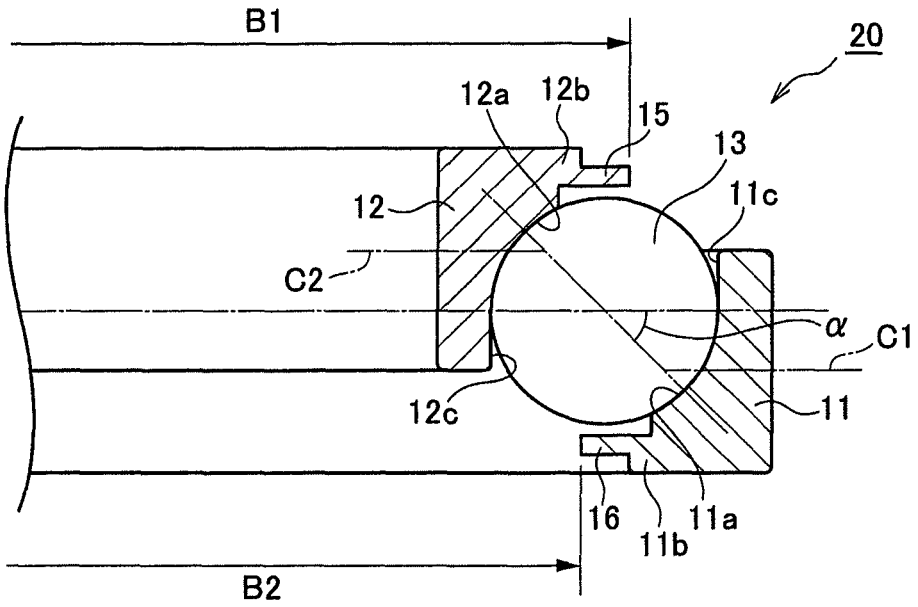
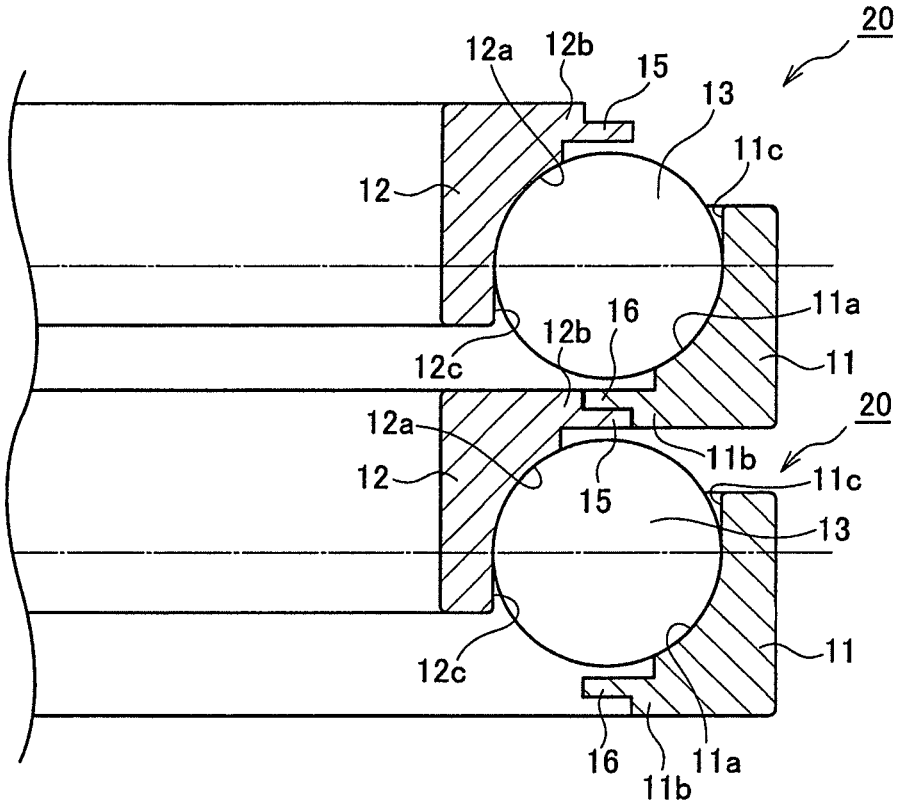


FIG. 4


20
12a
12b
15
13
11c
12
11a
16
12b
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11
20
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13
11
12c
16
11b
11a

FIG. 5
Related Art

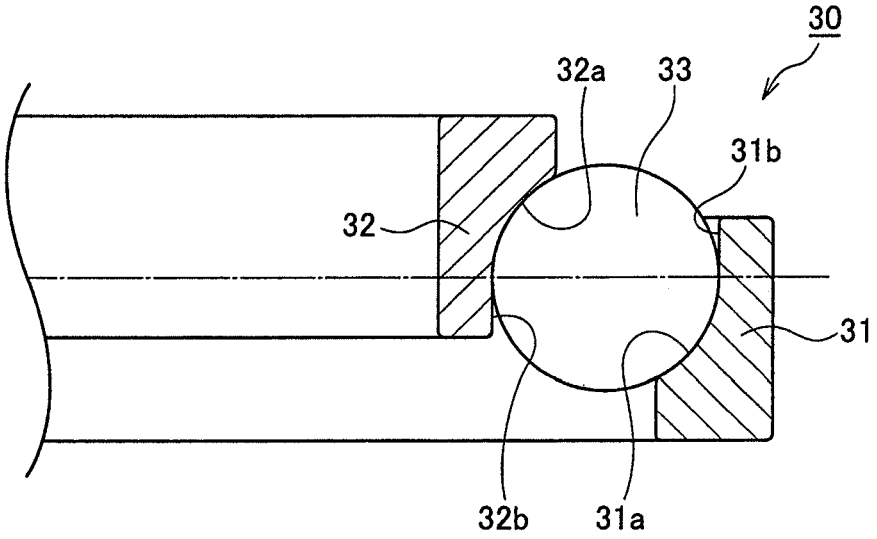
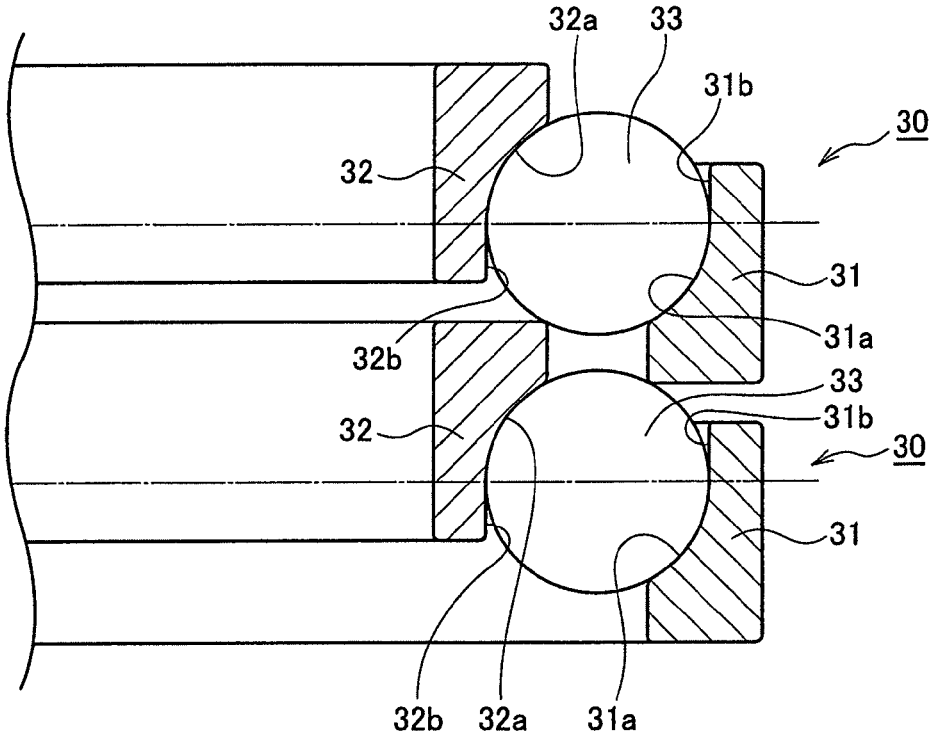


FIG. 6

Related Art



ANGULAR BALL BEARING

TECHNICAL FIELD

The present invention relates to an angular ball bearing, and more particularly, to an angular ball bearing having high load capacity and suitably used to support the rotating shafts of various heavy mechanical apparatuses.

BACKGROUND ART

A conventional angular ball bearing is equipped with an outer ring, on the inner circumferential surface of which a raceway surface is provided; an inner ring, on the outer circumferential surface of which a raceway surface is provided; and a plurality of balls provided between the raceway surfaces so as to be rotatable at a contact angle. This kind of bearing is built in various heavy mechanical apparatuses, such as speed reducers for industrial robots and construction machines.

In recent years, as these heavy mechanical apparatuses have been made smaller in size and lighter in weight, this kind of bearing has also been required not only to be made lower in cost but also to be made lighter in weight. For the purpose of cost reduction and weight reduction, as in the case of an angular ball bearing **30** shown in FIG. **5**, the axial dimensions of the outer ring **31** and the inner ring **32** thereof have been made smaller.

In this angular ball bearing **30**, the axial dimensions of the outer ring **31** and the inner ring **32** are made smaller, a counter bore **31***b* is formed on one side of the raceway surface **31***a* of the outer ring **31**, and a counter bore **32***b* is formed on the other side of the raceway surface **32***a* of the inner ring **32**; furthermore, since the axial dimensions of the outer ring **31** and the inner ring **32** are made small, a portion of each ball **33** protrudes from the axial end face of the outer ring **31** or the inner ring **32**.

When this kind of bearing is produced, in particular, in an assembly process or a conveying process, the plurality of angular ball bearings **30** having been assembled are stacked in the axial direction, whereby, as shown in FIG. **6**, the above-mentioned protruding portion of the ball **33** of one bearing makes contact with the outer ring **31** or the inner ring **32** of the bearing that is stacked thereon, and the surface of the ball **33** is likely to be damaged.

Hence, for the purpose of preventing the ball **33** from being damaged, as a conventional angular ball bearing, an angular ball bearing is known (for example, refer to Patent Document 1) that is characterized in that the bearings are stacked by using the retainers thereof for support purposes during storage and conveying.

PRIOR ART DOCUMENT

Patent Document

Patent Document 1: JP-A-2008-39069

SUMMARY OF THE INVENTION

Problem that the Invention is to Solve

However, in the angular ball bearing described in the above-mentioned Patent Document 1, since the stacked angular ball bearings are supported by the retainers, a large load is exerted to the retainers; this is undesirable in consideration of the strength of the retainers. Furthermore, since the angular ball bearing described in the above-mentioned Patent Document 1 is configured on the assumption that the bearings are stacked at the retainers, the degree of freedom in the design of the retainer is limited.

In consideration of the above-mentioned circumstances, an object of the present invention is to provide an angular ball bearing that can be stacked without damaging the balls thereof.

Means for Solving the Problems

(1) An angular ball bearing comprising: an outer ring comprising: a raceway surface on the inner circumferential surface thereof; a shoulder portion on one side of the raceway surface; and a counter bore on the other side of the raceway surface; an inner ring comprising: a raceway surface on the outer circumferential surface thereof; a shoulder portion on one side of the raceway surface; and a counter bore on the other side of the raceway surface; a plurality of balls provided between the raceway surface of the outer ring and the raceway surface of the inner ring so as to be rotatable at a contact angle, wherein the outer diameter dimension of the shoulder portion of the inner ring is larger than the inner diameter dimension of the shoulder portion of the outer ring, and the shoulder portion of the outer ring and the shoulder portion of the inner ring are overlapped with each other when viewed in the axial direction.

(2) The angular ball bearing of the above item (1), wherein engagement portions are formed at the shoulder portion of the inner ring and at the shoulder portion of the outer ring, and wherein when the angular ball bearings are stacked on top of one another in the axial direction, the engagement portion formed at the shoulder portion of the inner ring of one of the angular ball bearings is engaged with the engagement portion formed at the shoulder portion of the outer ring of the other angular ball bearing.

(3) The angular ball bearing of the above item (1), wherein relief grooves are formed on the inner circumferential surface of the shoulder portion of the outer ring and on the outer circumferential surface of the shoulder portion of the inner ring.

Advantage of the Invention

According to the present invention, the outer diameter dimension of the shoulder portion of the inner ring is larger than the inner diameter dimension of the shoulder portion of the outer ring, and the shoulder portion of the outer ring and the shoulder portion of the inner ring are overlapped with each other as viewed in the axial direction, whereby when the angular ball bearings are stacked, interference is prevented between the balls of one bearing and the outer ring or the inner ring of the other bearing to be stacked thereon. Hence, the angular ball bearings can be stacked without using retainers and without damaging the balls.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an enlarged sectional view showing the main sections of a first embodiment of an angular ball bearing according to the present invention;

FIG. **2** is an enlarged sectional view showing the main sections of the angular ball bearings shown in FIG. **1** in a state of being stacked;

FIG. **3** is an enlarged sectional view showing the main sections of a second embodiment of the angular ball bearing according to the present invention;

FIG. **4** is an enlarged sectional view showing the main sections of the angular ball bearings shown in FIG. **3** in a state of being stacked;

FIG. **5** is an enlarged sectional view showing the main sections of the conventional angular ball bearing; and

FIG. **6** is an enlarged sectional view showing the main sections of the angular ball bearings shown in FIG. **5** in a state of being stacked.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

Respective embodiments of an angular ball bearing according to the present invention will be now described in detail with reference to the drawings.

First Embodiment

First, a first embodiment of the angular ball bearing according to the present invention will be described referring to FIGS. **1** and **2**.

An angular ball bearing **10** according to this embodiment is a thin angular ball bearing as shown in FIG. **1** and is equipped with an outer ring **11** having a raceway surface **11***a* on the inner circumferential surface thereof; an inner ring **12** having a raceway surface **12***a* on the outer circumferential surface thereof; and a plurality of balls **13** provided between the raceway surfaces **11***a* and **12***a* so as to be rotatable at a contact angle α. A shoulder portion **11***b* is formed on one side of the raceway surface **11***a* of the outer ring **11** in the axial direction, and a counter bore **11***c* is formed on the other side in the axial direction; furthermore, a shoulder portion **12***b* is formed on the other side of the raceway surface **12***a* of the inner ring **12** in the axial direction, and a counter bore **12***c* is formed on one side in the axial direction. The term "counter bore" means a shape having no shoulder portion on one of two sides in the axial direction. The outer ring **11**, the inner ring **12** and the balls **13** are produced using steel such as high chromium carbide bearing steel, carburized bearing steel or stainless steel for rolling bearings.

Furthermore, the axial dimensions of the outer ring **11** and the inner ring **12** on the respective counter bore sides thereof are shortened, whereby the rings are assembled so that the center position C**1** of the outer ring **11** in the axial direction and the center position C**2** of the inner ring **12** in the axial direction are offset in the axial direction (so that the outer ring **11** is positioned lower in FIG. **1**) and so that a portion of the outer ring **11** and a portion of the inner ring **12** are overlapped with each other as viewed in the radial direction.

Moreover, in this embodiment, the outer diameter dimension B**1** of the shoulder portion **12***b* of the inner ring **12** is larger than the inner diameter dimension B**2** of the shoulder portion **11***b* of the outer ring **11**, and the shoulder portion **11***b* of the outer ring **11** and the shoulder portion **12***b* of the inner ring **12** are overlapped with each other as viewed in the axial direction. The overlapping amount is preferably 0 to 40% of the diameter of the ball **13**, more preferably 5 to 35%.

What's more, relief grooves **11***d* and **12***d* are formed on the inner circumferential surface of the shoulder portion **11***b* of the outer ring **11** and on the outer circumferential surface of the shoulder portion **12***b* of the inner ring **12**, respectively, so that the inner circumferential surface and the outer circumferential surface extend in the directions of the tangents to the ball **13** as viewed in cross section.

When the angular ball bearing **10** is viewed from the inside in the radial direction, a portion of the ball **13** protrudes from the end face of the inner ring **12** on the counter bore side thereof; and when the angular ball bearing **10** is viewed from the outside in the radial direction, a portion of the ball **13** protrudes from the end face of the outer ring **11** on the counter bore side thereof.

In the angular ball bearing **10** configured as described above, for example, in the case that the two angular ball bearings **10** are stacked, as shown in FIG. **2**, the outer ring **11** of the angular ball bearing **10** on the upper side is placed on the inner ring **12** of the angular ball bearing **10** on the lower side, whereby the angular ball bearing **10** on the upper side is supported by the inner ring **12** of the angular ball bearing **10** on the lower side. Hence, the inner ring **12** of the angular ball bearing **10** on the lower side does not make contact with the balls **13** of the angular ball bearing **10** on the upper side, thereby preventing the balls **13** of the angular ball bearing **10** on the upper side from being damaged. Similarly, the outer ring **11** of the angular ball bearing **10** on the upper side does not make contact with the balls **13** of the angular ball bearing **10** on the lower side, thereby preventing the balls **13** of the angular ball bearing **10** on the lower side from being damaged.

As described above, in the angular ball bearing **10** according to this embodiment, the outer diameter dimension B**1** of the shoulder portion **12***b* of the inner ring **12** is larger than the inner diameter dimension B**2** of the shoulder portion **11***b* of the outer ring **11**, and the shoulder portion **11***b* of the outer ring **11** and the shoulder portion **12***b* of the inner ring **12** are overlapped with each other as viewed in the axial direction, whereby when the angular ball bearings **10** are stacked, supporting is performed at the inner ring **12**. For this reason, the angular ball bearings **10** can be stacked without damaging the balls **13**.

Nothing has been mentioned in the above-mentioned embodiment about a retainer. Since the retainer is not used for the stacking of the angular ball bearings **10**, the degree of freedom in the design of the retainer can be improved and any given retainer can be used.

Still further, since the relief grooves **11***d* and **12***d* are formed on the inner circumferential surface of the shoulder portion **11***b* of the outer ring **11** and on the outer circumferential surface of the shoulder portion **12***b* of the inner ring **12**, the inner circumferential surface of the shoulder portion **11***b* of the outer ring **11** and the outer circumferential surface of the shoulder portion **12***b* of the inner ring **12** can be ground easily at the time of production.

Second Embodiment

Next, a second embodiment of the angular ball bearing according to the present invention will be described referring to FIGS. **3** and **4**. Portions identical or equivalent to those of the above-mentioned first embodiment are designated by the identical or equivalent numerals and signs in the figures, and their descriptions are omitted or simplified.

Also in an angular ball bearing **20** according to this embodiment, as shown in FIG. **3**, the outer diameter dimension B**1** of the shoulder portion **12***b* of the inner ring **12** is larger than the inner diameter dimension B**2** of the shoulder portion **11***b* of the outer ring **11**, and the shoulder portion **11***b* of the outer ring **11** and the shoulder portion **12***b* of the inner ring **12** are overlapped with each other as viewed in the axial direction.

At the shoulder portion **11***b* of the outer ring **11**, an engagement portion **16** is formed such that the outside end face in the axial direction is cut off by a predetermined width around the entire circumstance in the circumferential direction from the tip portion thereof, and also at the shoulder portion **12***b* of the

inner ring **12**, an engagement portion **15** is formed such that the outside end face in the axial direction is cut off by a predetermined width around the entire circumstance in the circumferential direction from the tip portion thereof. The engagement portions **15** and **16** are formed so as to have the same width in the radial direction and the same depth in the axial direction.

In the angular ball bearing **20** configured as described above, in the case that the two angular ball bearings **20** are stacked, as shown in FIG. **4**, the outer ring **11** of the angular ball bearing **20** on the upper side is placed on the inner ring **12** of the angular ball bearing **20** on the lower side, whereby the angular ball bearing **20** on the upper side is supported by the inner ring **12** of the angular ball bearing **20** on the lower side. At this time, the engagement portion **16** formed at the shoulder portion **11***b* of the outer ring **11** of the angular ball bearing **20** on the upper side is engaged with the engagement portion **15** formed at the shoulder portion **12***b* of the inner ring **12** of the angular ball bearing **20** on the lower side.

Hence, the inner ring **12** of the angular ball bearing **20** on the lower side does not make contact with the balls **13** of the angular ball bearing **20** on the upper side, whereby the balls **13** of the angular ball bearing **20** on the upper side are not damaged. Similarly, the outer ring **11** of the angular ball bearing **20** on the upper side does not make contact with the balls **13** of the angular ball bearing **20** on the lower side, whereby the balls **13** of the angular ball bearing **20** on the lower side are not damaged. Moreover, since the engagement portions **15** and **16** are engaged with each other, the relative movement between the bearings is restricted, whereby the angular ball bearing **20** on the upper side is prevented from being displaced and dropping.

Although the shapes of the engagement portions **15** and **16** can be set as desired, it is preferable that when the bearings are stacked, the axially outside end face of the inner ring **12** of the angular ball bearing **20** on the lower side should be flush with the axially inside end face of the outer ring **11** of the angular ball bearing **20** on the upper side and the axially inside end face of the inner ring **12** of the angular ball bearing **20** on the lower side should be flush with the axially outside end face of the outer ring **11** of the angular ball bearing **20** on the upper side. With this configuration, the height of the stacked bearings can be reduced while avoiding contact with the balls **13**.

Nothing has been mentioned either in this embodiment about a retainer. Since the retainer is not used for the stacking of the angular ball bearings **20**, the degree of freedom in the design of the retainer can be improved and any given retainer can be used.

Also in this embodiment, relief grooves **11***d* and **12***d* may be formed on the inner circumferential surface of the shoulder portion **11***b* of the outer ring **11** in which the engagement portion **16** is formed and on the outer circumferential surface of the shoulder portion **12***b* of the inner ring **12** in which the engagement portion **15** is formed so that the inner circumferential surface and the outer circumferential surface extend in the directions of the tangents to the ball **13** as viewed in cross section.

The present invention is not limited to the bearings exemplified in the above-mentioned respective embodiments, but can be changed appropriately within a scope not departing from the gist of the present invention.

The present application is based on Japanese Patent Application (JP-A-2012-045626) filed on Mar. 1, 2012, the contents of which are incorporated herein by reference.

DESCRIPTION OF REFERENCE NUMERALS AND SIGNS

10, **20** angular ball bearing
11 outer ring
11*a* raceway surface
11*b* shoulder portion
11*c* counter bore
11*d* relief groove
12 inner ring
12*a* raceway surface
12*b* shoulder portion
12*c* counter bore
12*d* relief groove
13 ball
15 engagement portion
16 engagement portion
B**1** outer diameter dimension of shoulder portion of inner ring
B**2** inner diameter dimension of shoulder portion of outer ring
α contact angle

The invention claimed is:

1. An angular ball bearing comprising:
an outer ring comprising:
a raceway surface on the inner circumferential surface thereof;
a shoulder portion on one side of the raceway surface; and
a first counter bore on the other side of the raceway surface;
an inner ring comprising:
a raceway surface on the outer circumferential surface thereof;
a shoulder portion on one side of the raceway surface; and
a second counter bore on the other side of the raceway surface;
a plurality of balls provided between the raceway surface of the outer ring and the raceway surface of the inner ring so as to be rotatable at a contact angle,
wherein the outer diameter dimension of the shoulder portion of the inner ring is larger than the inner diameter dimension of the shoulder portion of the outer ring,
the shoulder portion of the outer ring and the shoulder portion of the inner ring are overlapped with each other when viewed in the axial direction,
the first counter bore having no shoulder portion on at least one side when viewed in the axial direction, and
wherein engagement portions are formed at the shoulder portion of the inner ring and at the shoulder portion of the outer ring such that the engagement portions each include a cut-out portion, and
wherein when the angular ball bearings are stacked on top of one another in the axial direction, the cut-out of the engagement portion formed at the shoulder portion of the inner ring of one of the angular ball bearings is engaged with the cut-out of the engagement portion formed at the shoulder portion of the outer ring of the other angular ball bearing.

2. The angular ball bearing of claim **1**, wherein relief grooves are formed on the inner circumferential surface of the shoulder portion of the outer ring and on the outer circumferential surface of the shoulder portion of the inner ring.

3. The angular ball bearing of claim **1**, wherein a portion of each of the plurality of balls protrudes from an end face of the inner ring on the counter bore side of the inner ring.

4. The angular ball bearing of claim **1**, wherein a portion of each of the plurality of balls protrudes from an end face of the outer ring on a counter bore side of the outer ring.

5. The angular ball bearing of claim **1**, wherein when the angular ball bearings are stacked on top of one another in the

axial direction an upper portion of an axially outer end face of the inner ring is flush with a lower portion of an axially outer end face of the outer ring.

* * * * *